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AF Ablation; Simplicity is the answer

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“ it’s technology married with liberal arts, married with the humanities, that yields us the results that make our heart sing”

Steve Jobs

The field of electrophysiology has long encompassed multiple different strands of science and industry in an attempt to yield better results for our patients. While subspecialisation of electrophysiology and electrophysiologists continues at a pace, at the same time our interdependence on others increases. Managing patients with atrial fibrillation (AF) often requires multiple specialists to assess and treat the co-morbidities that our patients have, while when considering who and how to ablate our patients we are increasing using ever more complex imaging and mapping systems. In almost twenty years from the initial description of pulmonary vein isolation, and the acceptance that this is the cornerstone of AF ablation we are still unable to consistently achieve this apparently simple task. In this issue of *The Journal*, *Taghji et al* (1) present their work which will potentially revolutionise the care of patients with AF and also our understanding of it by demonstrating how to achieve permanent pulmonary vein isolation safely and reliably.

Contact force has unsurprisingly long been known as an important factor in lesion creation (2). Similarly a drop in impedence during ablation is also a known marker of lesion creation (3, 4). While it took a while for catheters to be developed that were able to measure the degree of contact at the catheter tip, their use in cases is now ubiquitous. However, although it is perhaps obvious that procedures are better when the operator has the availability of contact force data, the trials have not supported this view (Table 1). If we explore the available data in more detail it is perhaps not that surprising. Until recently there has been little histological correlation between force and lesion creation and lesion transmurality (5), which has perhaps given rise to the wide variation in contact force values used in trials. Similarly, although preclinical work on lesion creation has been performed this is rarely done in the atria (6). Ablation of the thin walled atrium is clearly different from ablation in the thicker walled ventricle or canine thigh preparation model. While data apparently demonstrating the accuracy of indices of ablation has been performed, an accuracy of ±1mm is clearly different when ablating the atrial wall which can be 1-2mm compared to the ventricle (6). The problem with all current technologies is that tissue thickness is not taken into account (7). While this is clearly an important variable, and tissue thickness varies widely, only ultrasound so far has been used to measure this during ablation (8).

In this issue of the journal *Taghji et al* (1) present work on a series of 130 patients undergoing first time ablation for paroxysmal AF. Using objective measures of lesion creation (ablation Index, AI) and importantly objectively measuring and keeping within a maximal interlesion distance of 6mm, they demonstrated both a high rate of acute 1st pass pulmonary vein isolation and more importantly, that by using these objective measures a very high level of clinical success at 1 year following the ablation. This work was made possible by a thorough understanding of the biophysics of radiofrequency, application of technology at the catheter tip and displaying the complex information to the end user. A true intersection of a number of different skills. Other markers of lesion creation, such as impedence drop (Median drop 12.7 Ohms) were consistent with good quality lesions. The 1 year success rate is remarkable, with a 91% freedom from AF in all patients. What is perhaps even more interesting is in the patients that had to return for a second ablation, only 1 of the 10 patients had reconnection of the pulmonary veins that could not be explained by low AI or poor lesion contiguity.

While the success of the procedure using these parameters is excellent, this is still a work in progress, and can be refined. The values for AI, while based on some pre-clinical and clinical work, are arbitrary. It is notable that in 40% of the cases the lesions on the posterior wall did not meet the pre-defined criteria of an AI of 400 due to a rise in oesophageal temperature. Despite this AF was adequately treated for these patients. It is almost certainly the case that the values used for AI are more than what is required. While finessing of the AI values will likely be attempted in similar studies, perhaps it is time to take a different approach to such questions. In many fields, both within medicine and outside medicine, big data approaches have paid dividends (9, 10). While significant regulatory hurdles exist to sharing personal data the potential benefits to understanding how to utilise AI and having a “correct” target number, as opposed to something divisible by 10, should outweigh our prejudices. Additionally, although the complication rate from AF ablation is low in most reported studies, especially for atrial oesophageal fistula, it is probable that more energy is being delivered than is absolutely necessary, rendering the necessity for assessment of tissue thickness less of an issue. However, with widespread use of ablation index it is likely that some patients will unfortunately have this complication. Individual case reports will not help us understand this, but national or international registries and big data approaches could be helpful.

This study focused on patients with paroxysmal AF, as is right when trying a new approach, to have as homogenous population as possible. Clearly though knowing that we really can do what we are attempting to achieve will help us understand persistent AF more than at present. Following the STAR AF II data, strategies that involve more than just pulmonary vein isolation have come under closer scrutiny. While we have been unable to reliably achieve permanent block across linear lesions, or reliably isolate the posterior wall, it is difficult to fully understand whether the failure is due to the strategy or the deployment of lesions. The use of the algorithm presented may allow us to answer these questions once and for all. When there is certainty about the outcome, novel lesion sets may be used. For example, complete isolation of the posterior wall and pulmonary veins can be achieved with one contiguous lesion set, “the big box” Figure 1.

Finally, is it time to re-examine the blanking period? With health systems under financial pressure a shorter duration of follow up is preferable for many reasons. Currently given the relatively high rate of recurrence, follow up periods for at least a year are commonplace. However, if the results of this study are replicated in real world practice and future studies reproduce these data it may be that absence of arrhythmia within the blanking period will portend a good clinical result from ablation.

Just as Apple were not the first to introduce a portable digital music player with the iPod, or the first to introduce a phone to connect to the internet, the concept of good quality contiguous lesions to achieve permanent pulmonary vein isolation is neither new nor novel. However, the elegant execution of these tasks will likely revolutionise the treatment of patients with atrial fibrillation, just as the iPod and iPhone revolutionised their respective markets.

Figure 1. “Big Box” isolation. In this patient the entire posterior wall was isolated with one set of contiguous lesions with an ablation index of 400 and an interlesion distance <6mm. On completion of the box the posterior wall and veins were isolated. This strategy minimises the amount of ablation on the posterior wall compared to separet lesion sets to isolate the veins and then isolate the posterior wall.

Table 1. Trials of Contact Force

Study	Patient Population	Contact force range	Strategy	Outcome
Toccastar (11)	Paroxysmal AF, 300 patients	No target range specified	Pulmonary vein isolation only	No difference in primary outcome vs. non contact force (67.8% Contact force group)
Smart AF (12)	Paroxysmal AF, 160 patients	No target range specified	Multiple strategies employed	74% 1 year arrhythmia free survival
UK Multicentre Trial Group(13)	Paroxysmal AF, 117 patients	5-40g	Pulmonary vein isolation only	49% 1 year success rate, no difference between groups
Touch AF (14)	Persistent AF, 160 patients	10-20g	PV antral ablation and roof line	61% 1 year arrhythmia free survival; no difference between groups

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